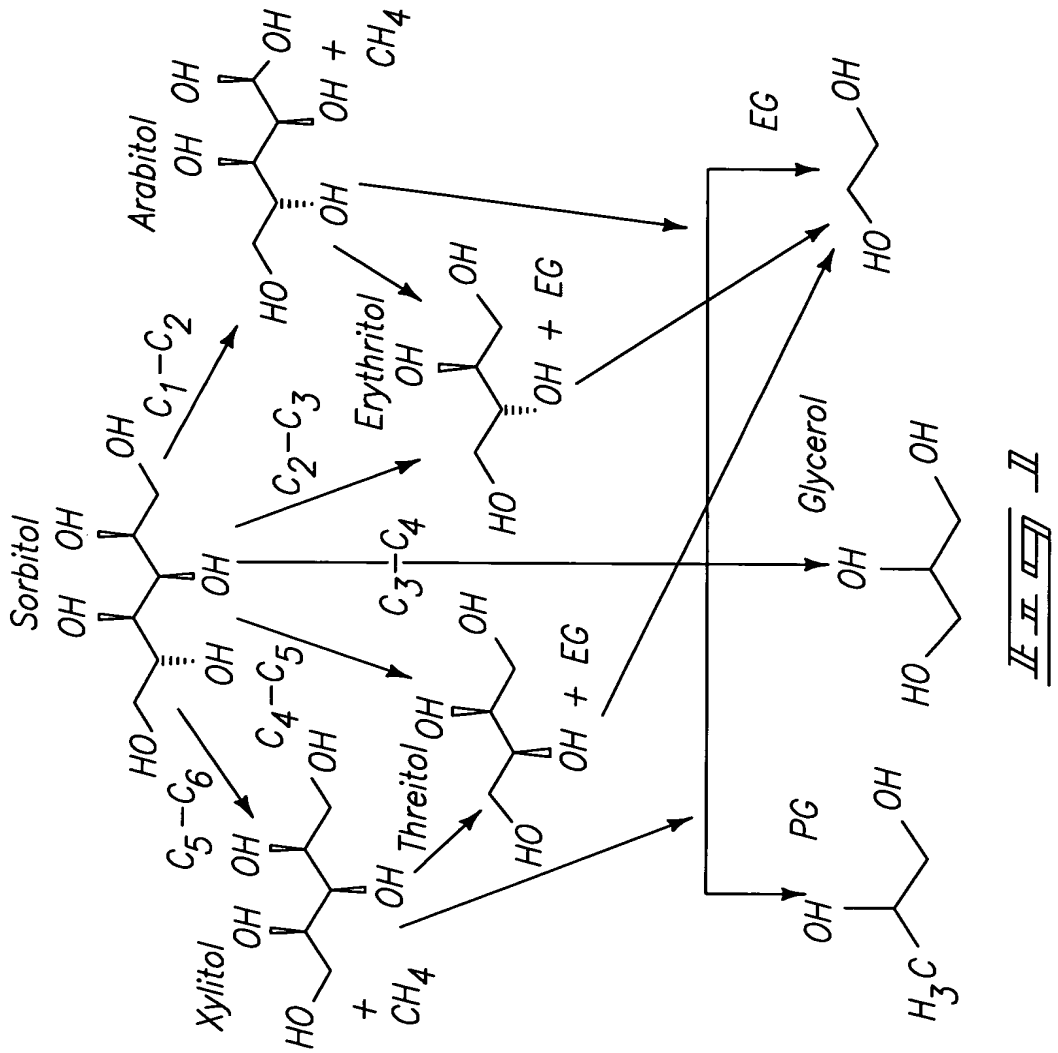
Sorbitol
Arabitol
Erythritol
Threitol
Xylitol
Glycerol
EG
PG
C_1-C_2
C_2-C_3
C_3-C_4
C_4-C_5
C_5-C_6
+ EG
+ CH_4
OH
HO
H_3C

Фиг. 2

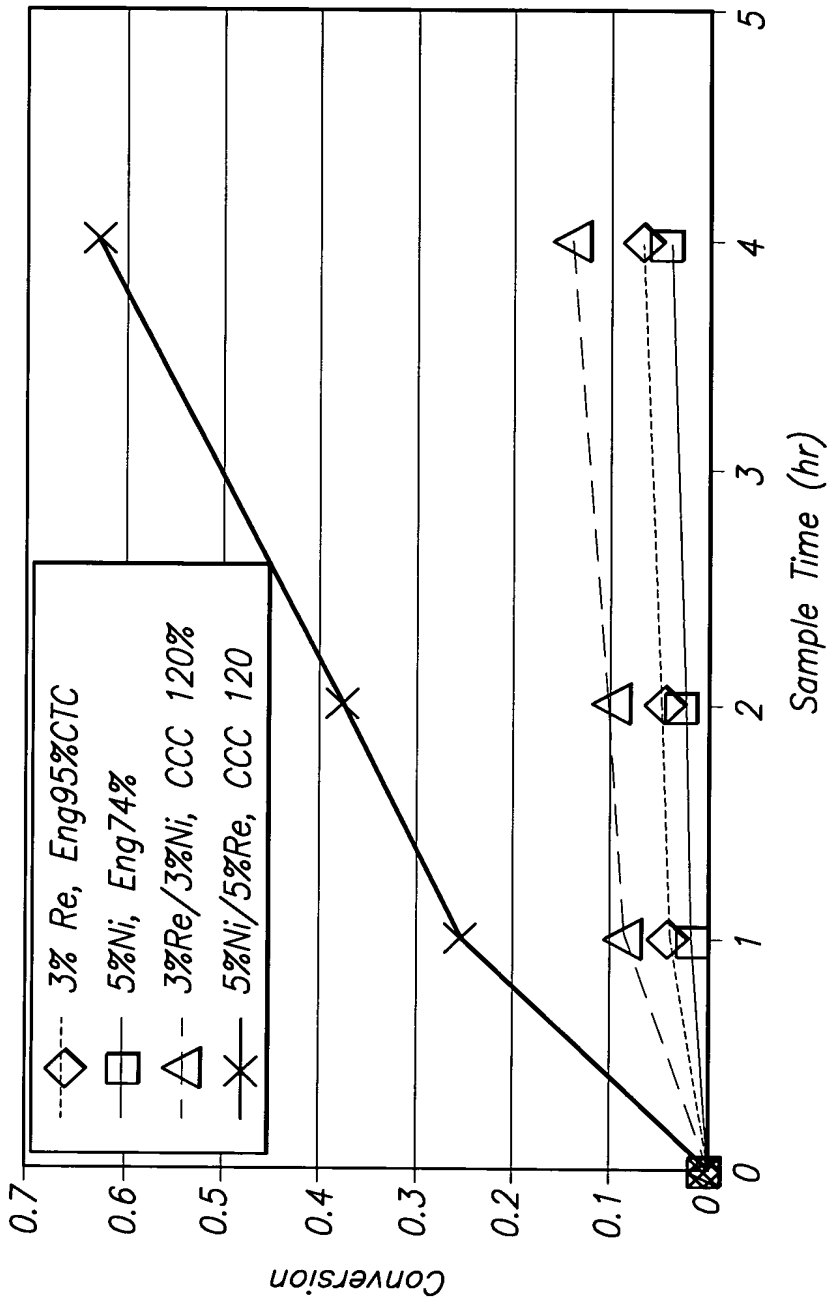
Conversion
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
Sample Time (hr)
3% Re, Eng95%CTC
5%Ni, Eng74%
3%Re/3%Ni, CCC 120%
5%Ni/5%Re, CCC 120

Fig 2

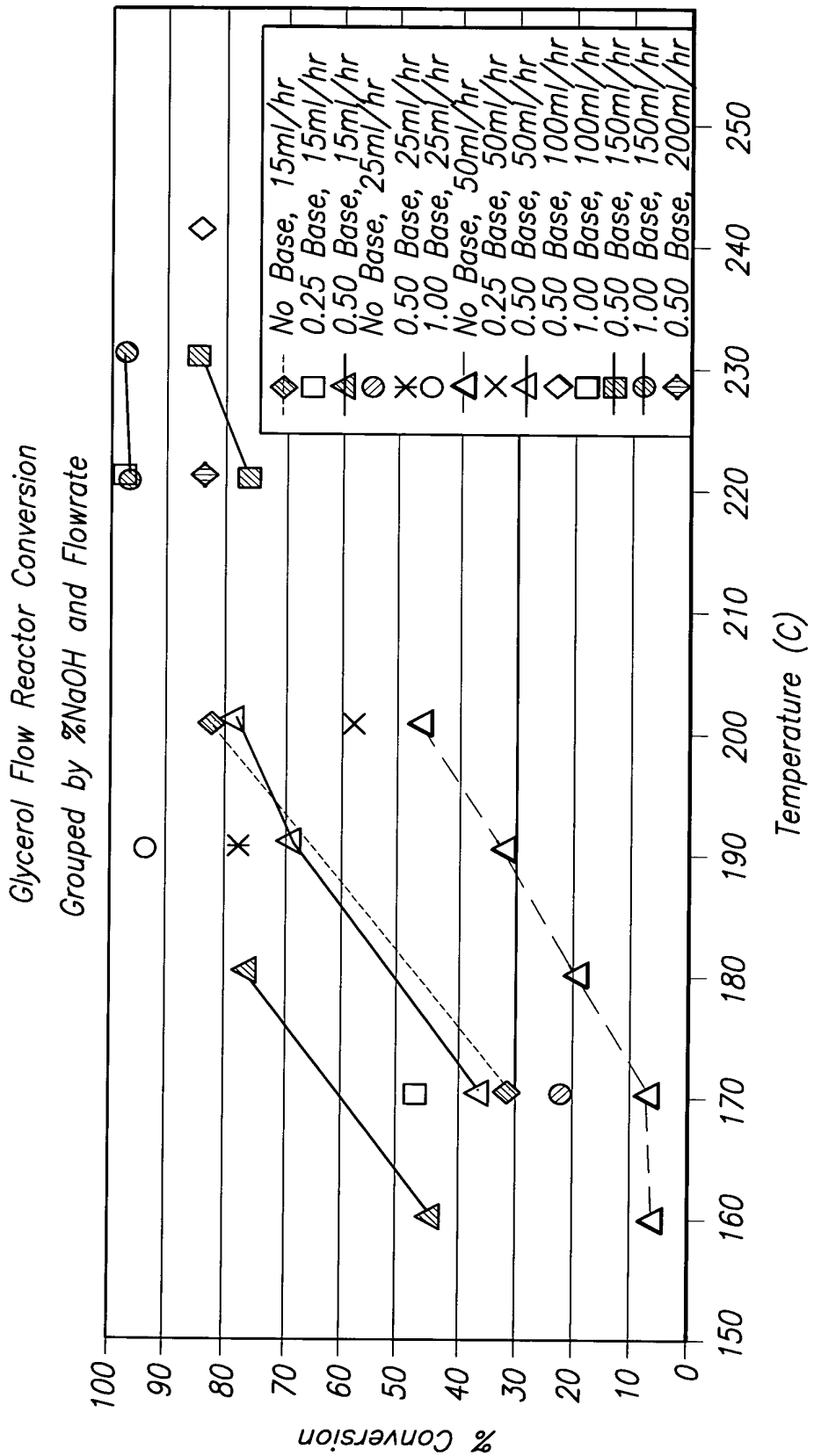
Glycerol Flow Reactor Conversion
Grouped by %NaOH and Flowrate
% Conversion
Temperature (C)
100
90
80
70
60
50
40
30
20
10
0
150
160
170
180
190
200
210
220
230
240
250
No Base, 15ml/hr
0.25 Base, 15ml/hr
0.50 Base, 15ml/hr
No Base, 25ml/hr
0.50 Base, 25ml/hr
1.00 Base, 25ml/hr
No Base, 50ml/hr
0.25 Base, 50ml/hr
0.50 Base, 50ml/hr
0.50 Base, 100ml/hr
1.00 Base, 100ml/hr
0.50 Base, 150ml/hr
1.00 Base, 150ml/hr
0.50 Base, 200ml/hr

FIG 3

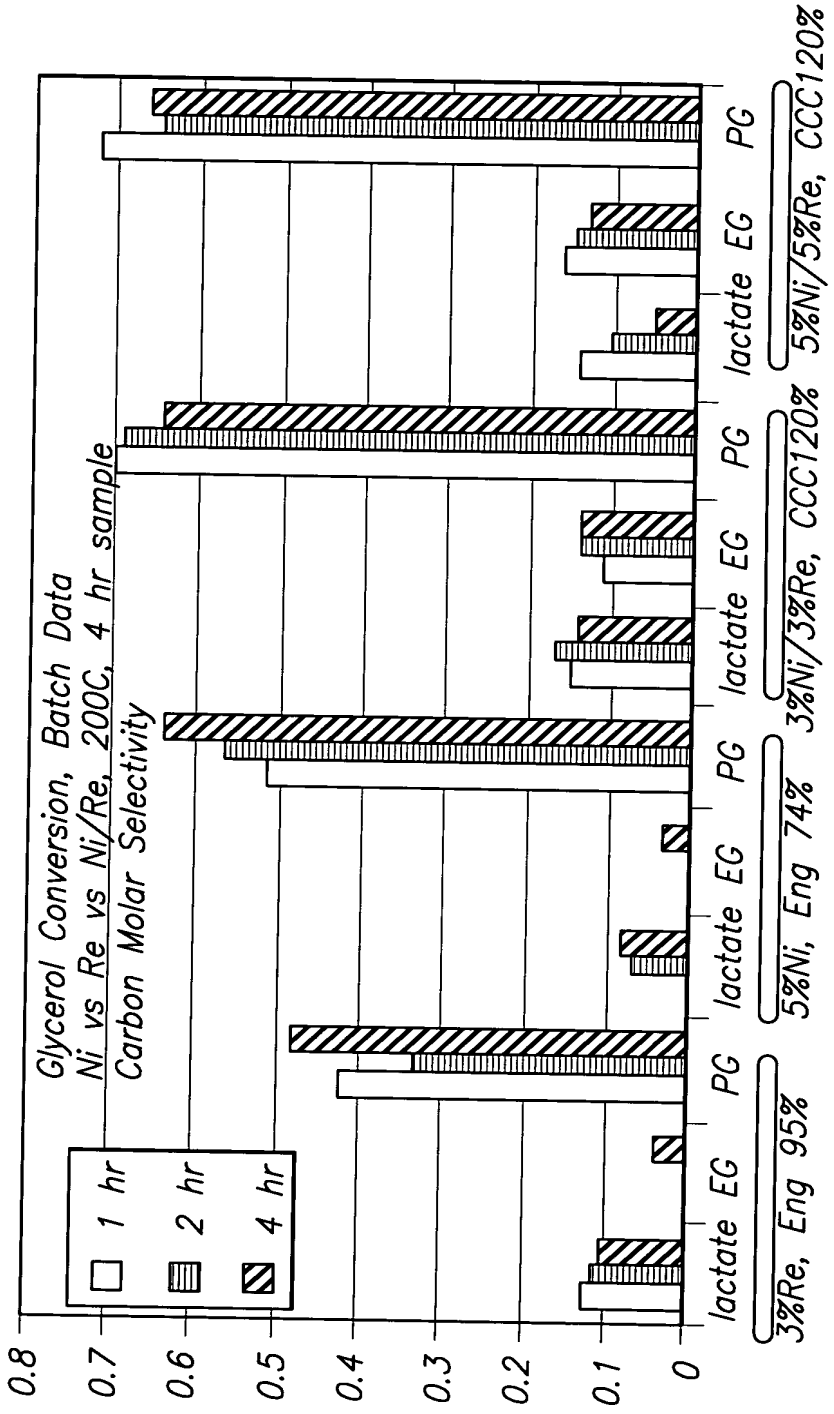
Glycerol Conversion, Batch Data
Ni vs Re vs Ni/Re, 200C, 4 hr sample
Carbon Molar Selectivity
1 hr
2 hr
4 hr
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
lactate EG PG
3%Re, Eng 95%
lactate EG PG
5%Ni, Eng 74%
lactate EG PG
3%Ni/3%Re, CCC120%
lactate EG PG
5%Ni/5%Re, CCC120%

Fig 11

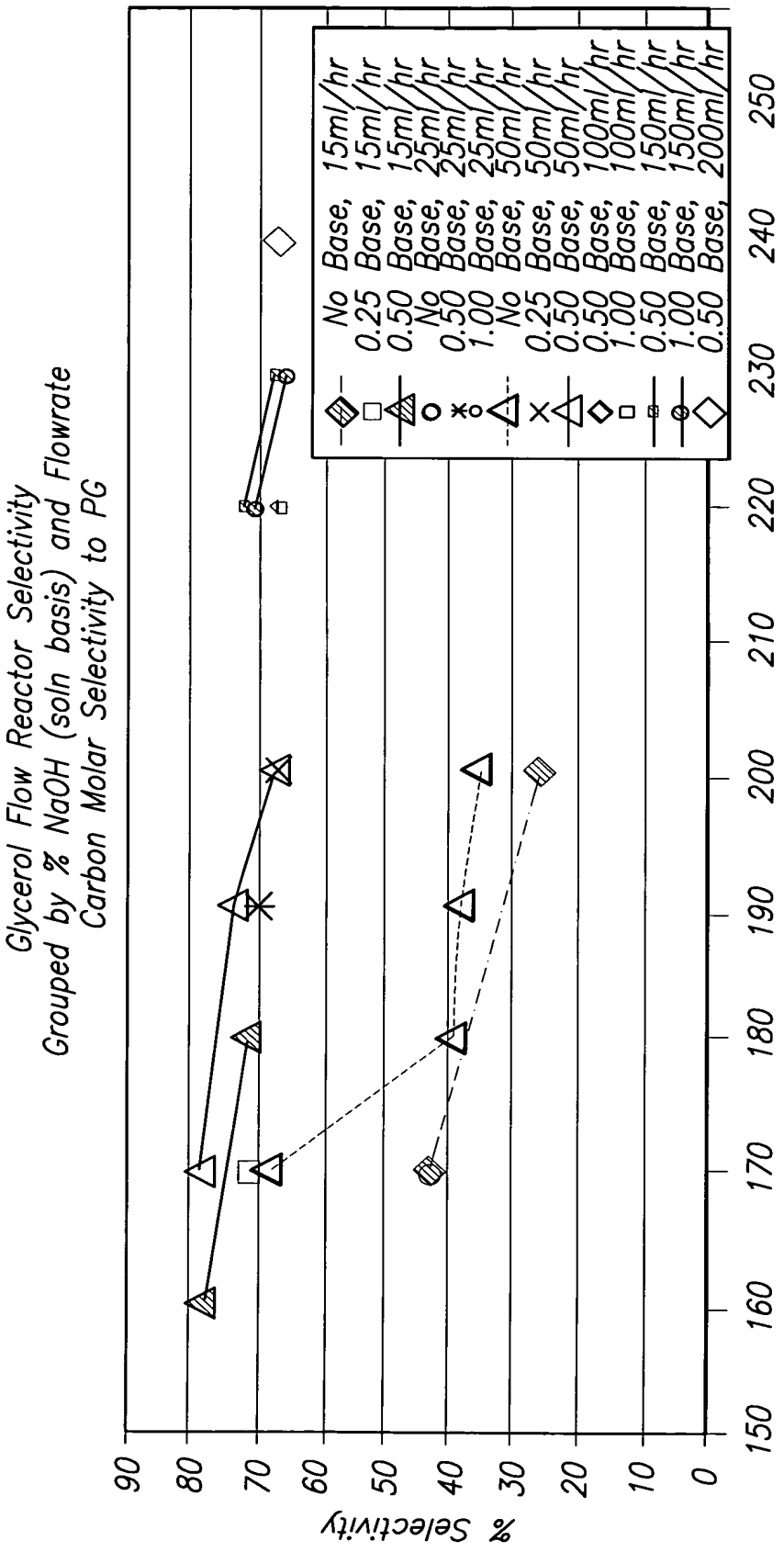
Glycerol Flow Reactor Selectivity
Grouped by % NaOH (soln basis) and Flowrate
Carbon Molar Selectivity to PG
% Selectivity
Temperature (C)
0
10
20
30
40
50
60
70
80
90
150
160
170
180
190
200
210
220
230
240
250
No Base, 15ml/hr
0.25 Base, 15ml/hr
0.50 Base, 15ml/hr
No Base, 25ml/hr
0.50 Base, 25ml/hr
1.00 Base, 25ml/hr
No Base, 50ml/hr
0.25 Base, 50ml/hr
0.50 Base, 50ml/hr
0.50 Base, 100ml/hr
1.00 Base, 100ml/hr
0.50 Base, 150ml/hr
1.00 Base, 150ml/hr
0.50 Base, 200ml/hr

Fig 5

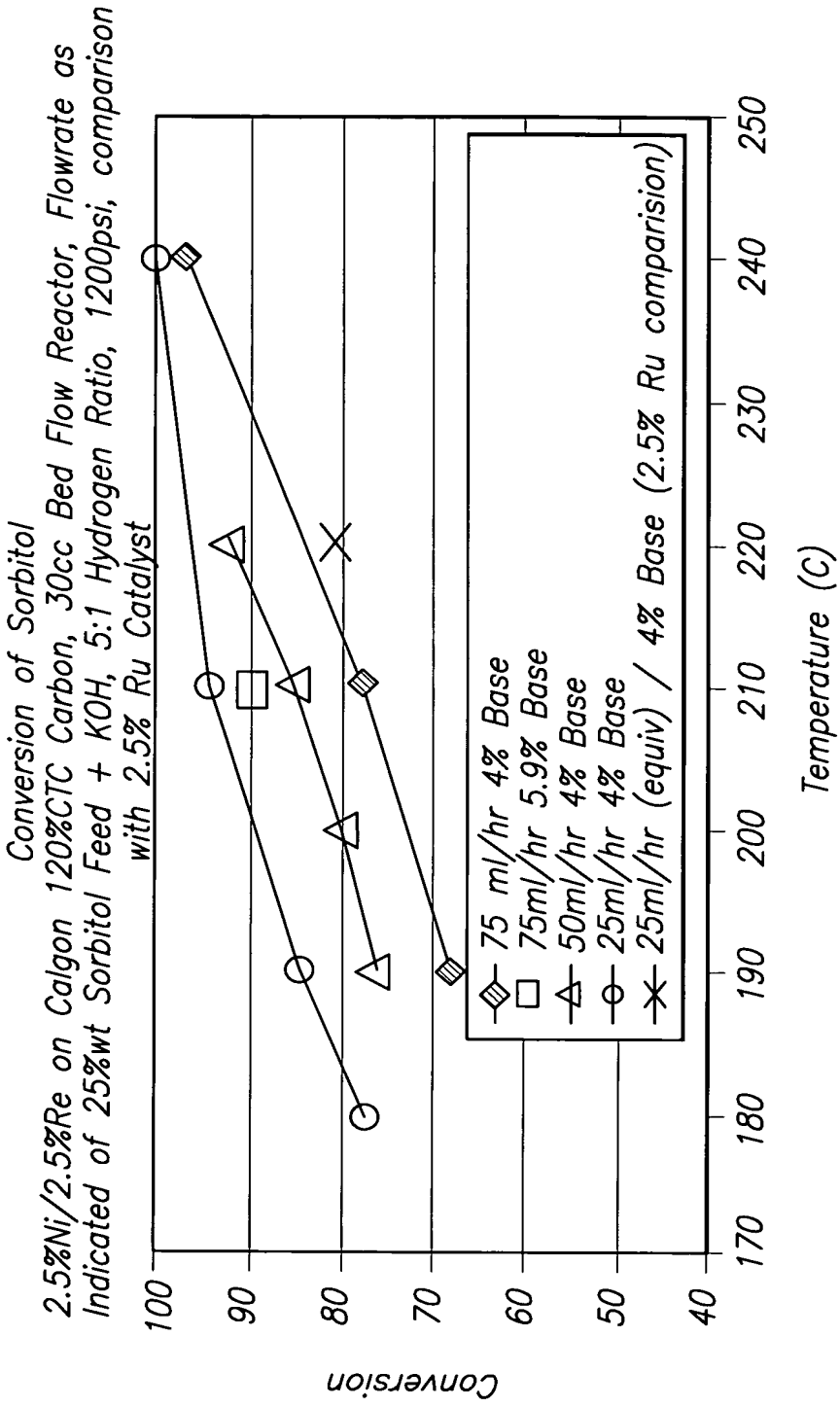
Conversion of Sorbitol
2.5%Ni/2.5%Re on Calgon 120%CTC Carbon, 30cc Bed Flow Reactor, Flowrate as Indicated of 25%wt Sorbitol Feed + KOH, 5:1 Hydrogen Ratio, 1200psi, comparison with 2.5% Ru Catalyst
Conversion
100
90
80
70
60
50
40
170
180
190
200
210
220
230
240
250
Temperature (C)
75 ml/hr 4% Base
75ml/hr 5.9% Base
50ml/hr 4% Base
25ml/hr 4% Base
25ml/hr (equiv) / 4% Base (2.5% Ru comparision)

FIG 5

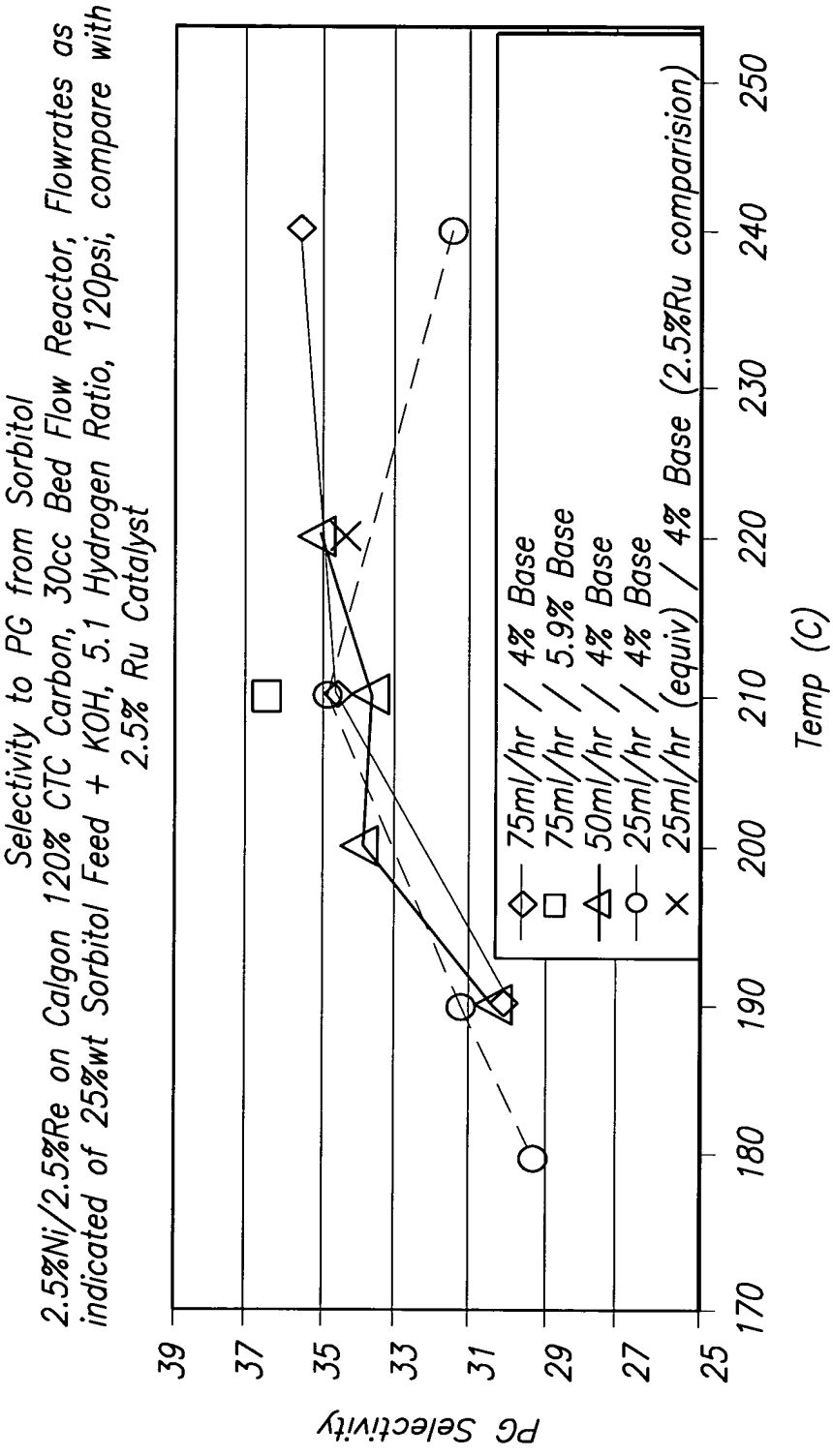
Selectivity to PG from Sorbitol
2.5%Ni/2.5%Re on Calgon 120% CTC Carbon, 30cc Bed Flow Reactor, Flowrates as indicated of 25%wt Sorbitol Feed + KOH, 5.1 Hydrogen Ratio, 120psi, compare with 2.5% Ru Catalyst
PG Selectivity
Temp (C)
75ml/hr / 4% Base
75ml/hr / 5.9% Base
50ml/hr / 4% Base
25ml/hr / 4% Base
25ml/hr (equiv) / 4% Base (2.5%Ru comparision)

FIG II

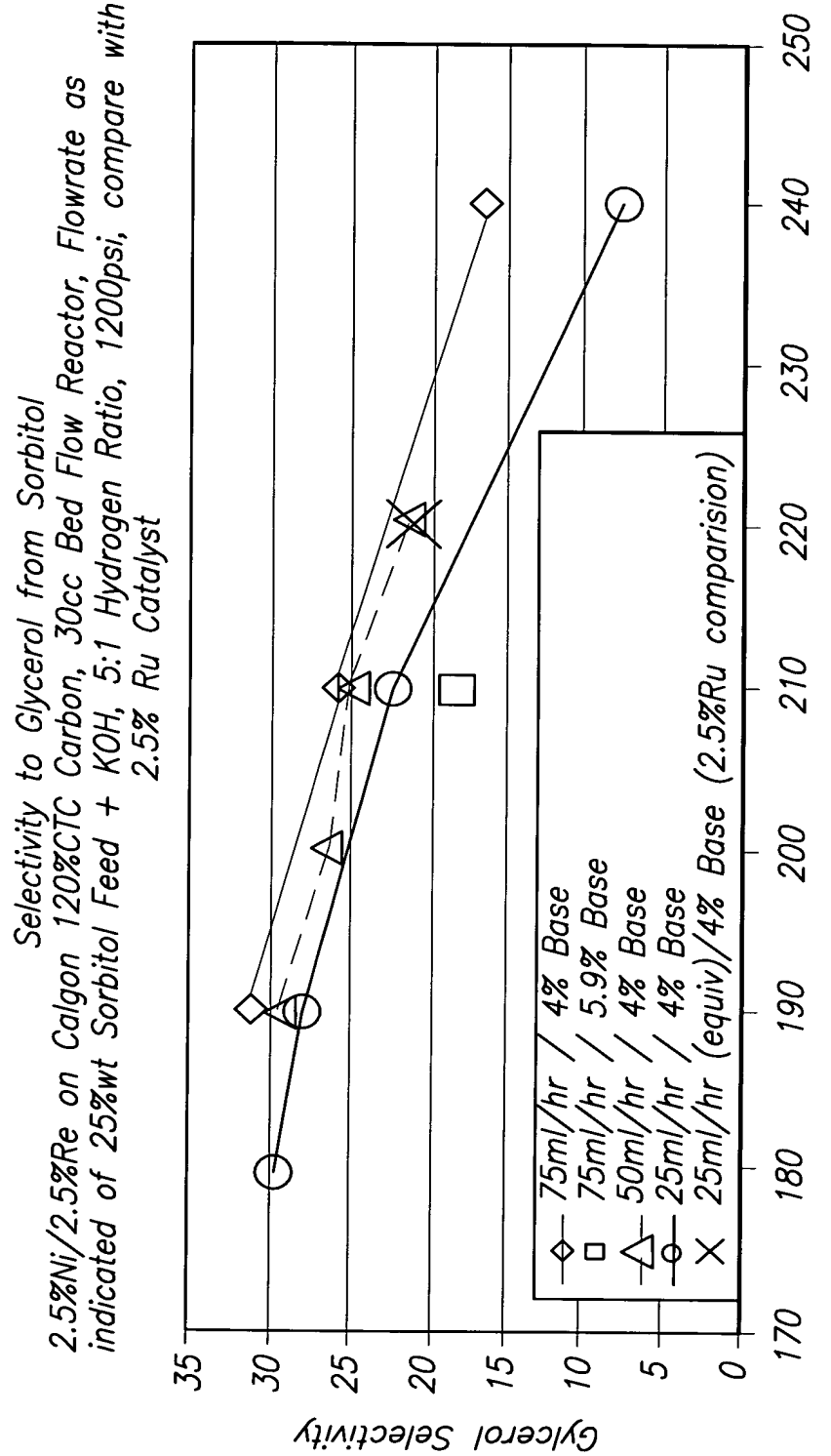
Selectivity to Glycerol from Sorbitol
2.5%Ni/2.5%Re on Calgon 120%CTC Carbon, 30cc Bed Flow Reactor, Flowrate as indicated of 25%wt Sorbitol Feed + KOH, 5:1 Hydrogen Ratio, 1200psi, compare with 2.5% Ru Catalyst
Glycerol Selectivity
Temp (C)
75ml/hr / 4% Base
75ml/hr / 5.9% Base
50ml/hr / 4% Base
25ml/hr / 4% Base
25ml/hr (equiv)/4% Base (2.5%Ru comparision)
0
5
10
15
20
25
30
35
170
180
190
200
210
220
230
240
250

FIG 8

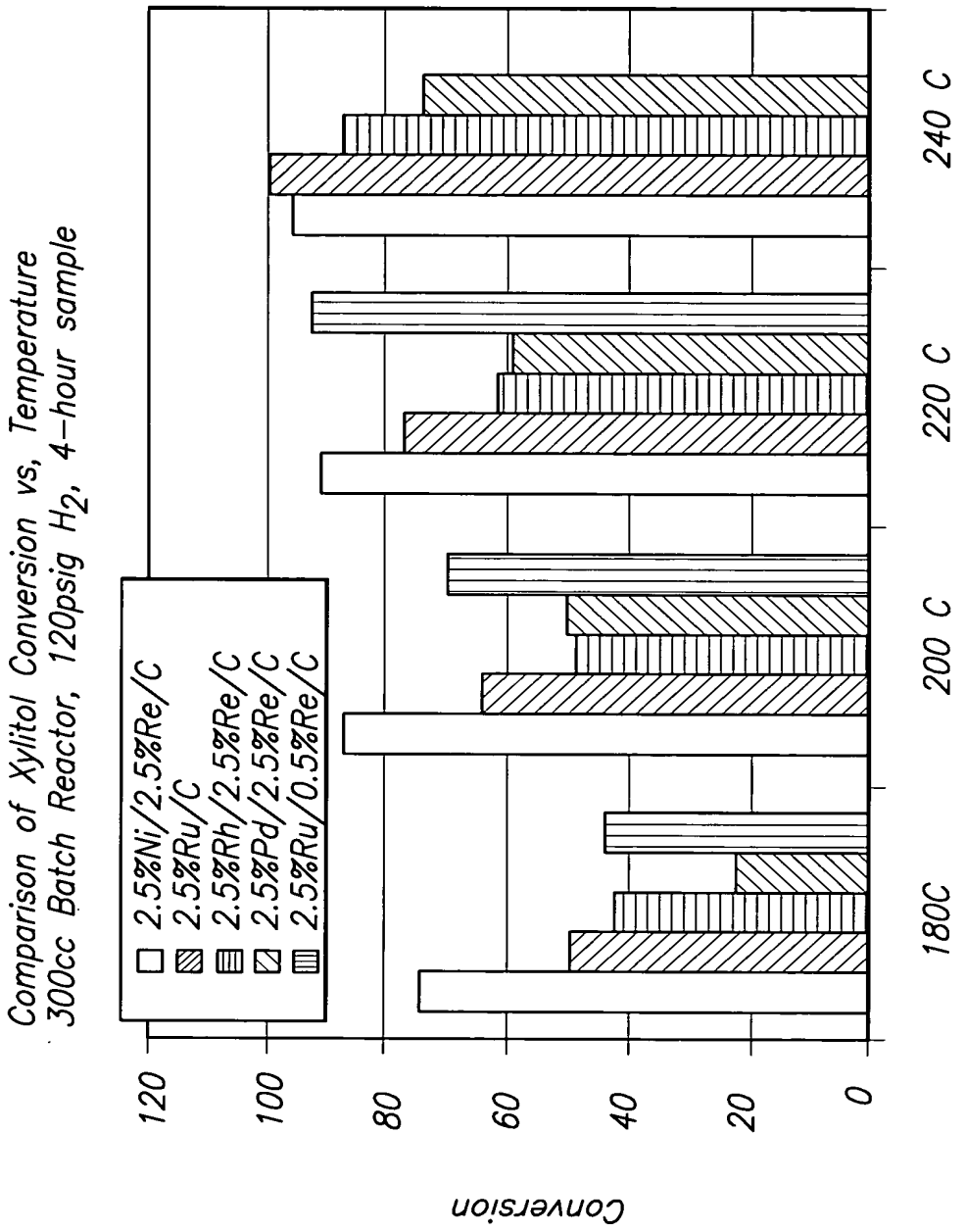
Comparison of Xylitol Conversion vs, Temperature
300cc Batch Reactor, 120psig H_2, 4-hour sample
2.5%Ni/2.5%Re/C
2.5%Ru/C
2.5%Rh/2.5%Re/C
2.5%Pd/2.5%Re/C
2.5%Ru/0.5%Re/C
Conversion
120
100
80
60
40
20
0
180C
200 C
220 C
240 C

Fig 9

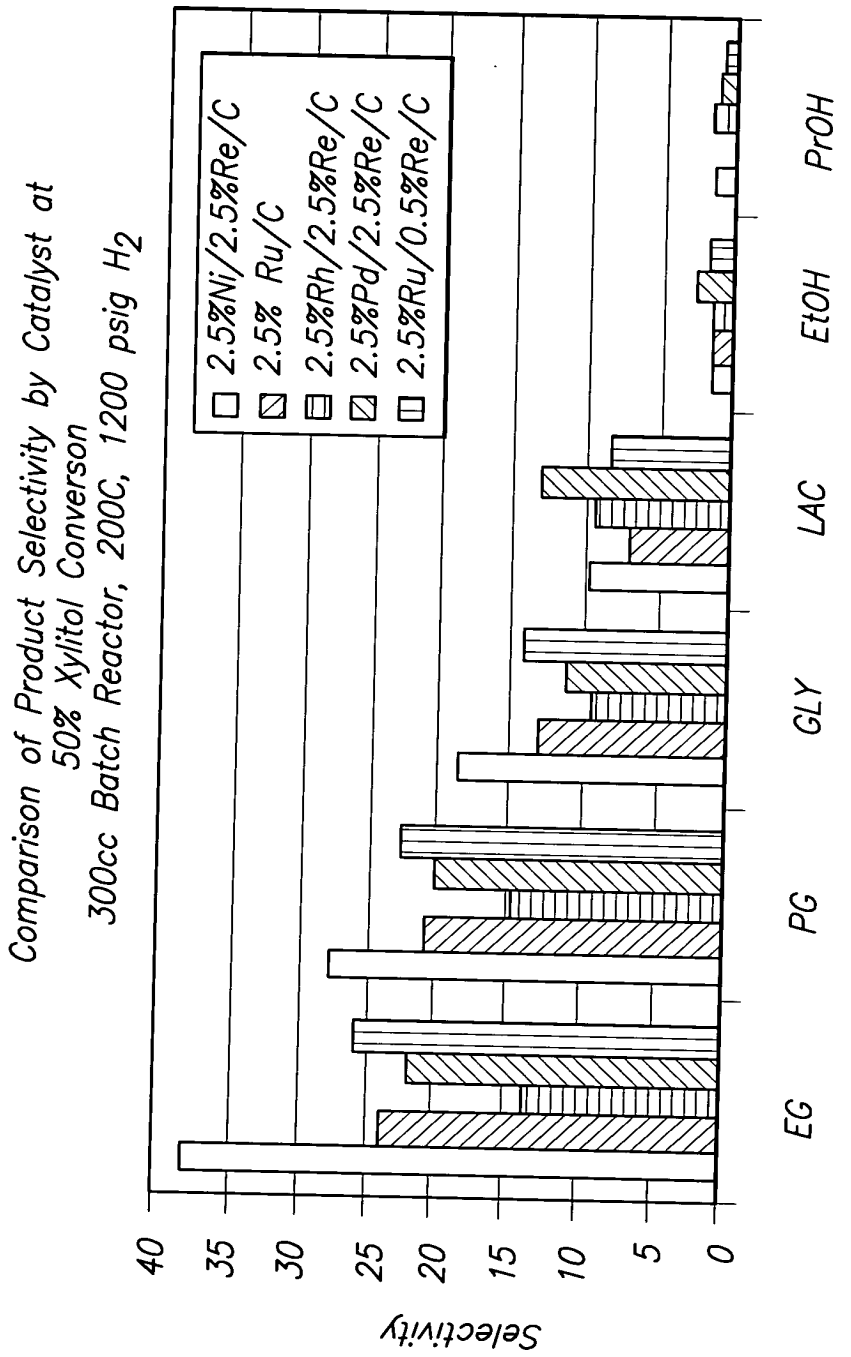
Comparison of Product Selectivity by Catalyst at
50% Xylitol Converson
300cc Batch Reactor, 200C, 1200 psig H_2
2.5%Ni/2.5%Re/C
2.5% Ru/C
2.5%Rh/2.5%Re/C
2.5%Pd/2.5%Re/C
2.5%Ru/0.5%Re/C
Selectivity
0
5
10
15
20
25
30
35
40
EG
PG
GLY
LAC
EtOH
PrOH

FIG 11

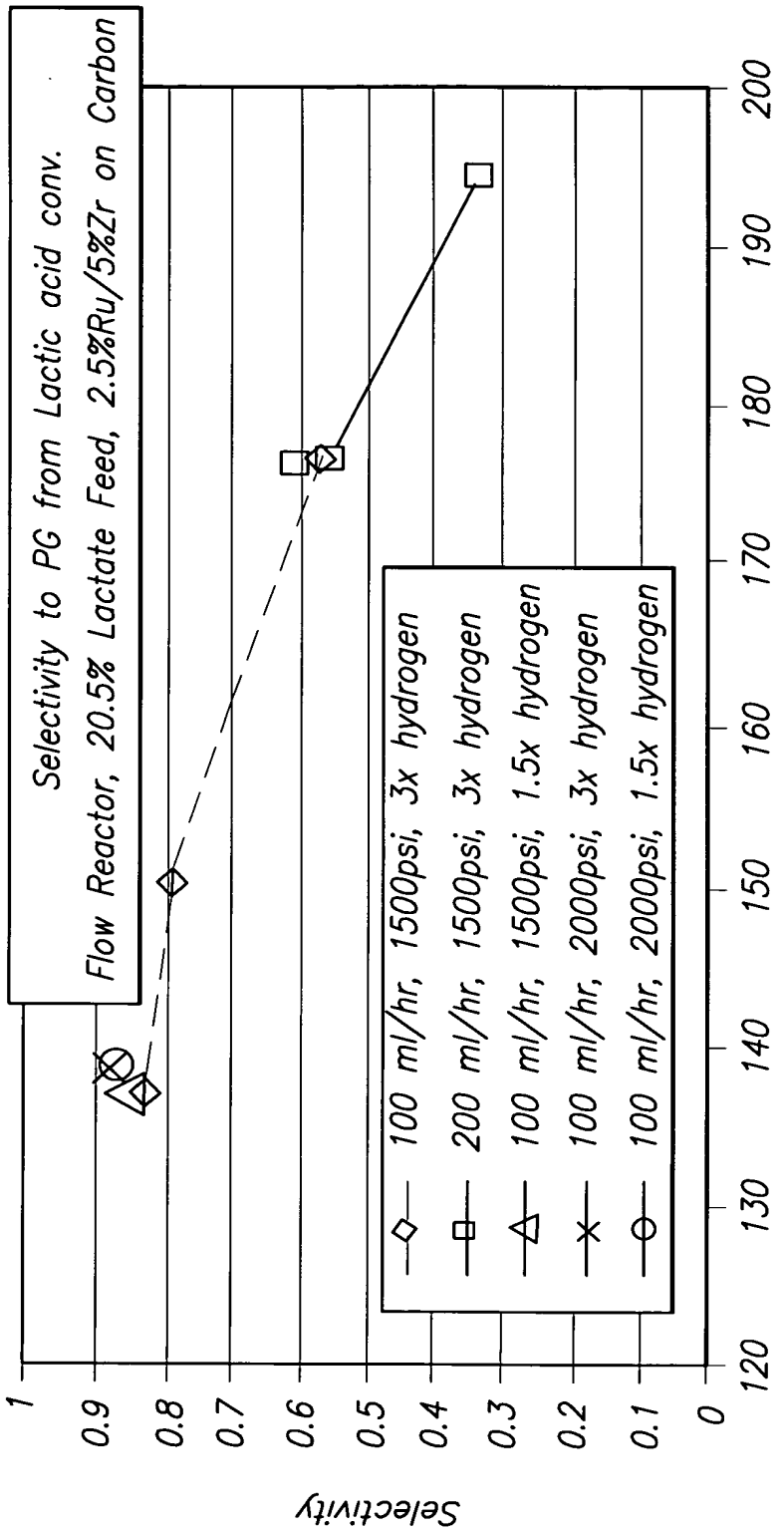
Selectivity to PG from Lactic acid conv.
Flow Reactor, 20.5% Lactate Feed, 2.5%Ru/5%Zr on Carbon
100 ml/hr, 1500psi, 3x hydrogen
200 ml/hr, 1500psi, 3x hydrogen
100 ml/hr, 1500psi, 1.5x hydrogen
100 ml/hr, 2000psi, 3x hydrogen
100 ml/hr, 2000psi, 1.5x hydrogen
Selectivity
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
120
130
140
150
160
170
180
190
200
Temp (C)

FIG 11

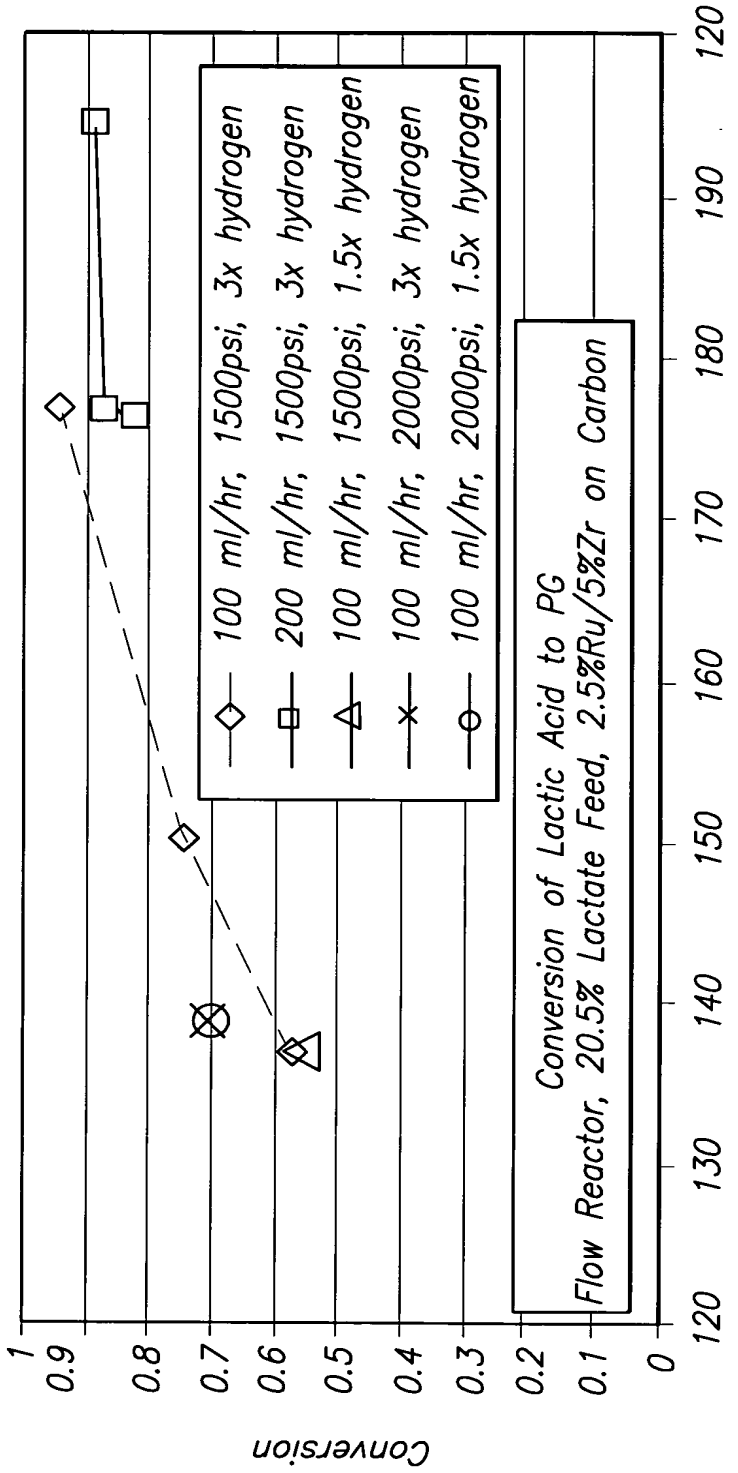
Conversion
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
120
130
140
150
160
170
180
190
120
Temp (C)
100 ml/hr, 1500psi, 3x hydrogen
200 ml/hr, 1500psi, 3x hydrogen
100 ml/hr, 1500psi, 1.5x hydrogen
100 ml/hr, 2000psi, 3x hydrogen
100 ml/hr, 2000psi, 1.5x hydrogen
Conversion of Lactic Acid to PG
Flow Reactor, 20.5% Lactate Feed, 2.5%Ru/5%Zr on Carbon

Fig 12